

Remarks

Claims 1 and 5-9 are currently pending in the application.

In the instant Amendment, claim 1 has been amended to recite that the steel contains not less than 78.6 mass% of Al₂O₃ in the inclusions. Support for this amendment is found, for example, in Table 2 of the specification, which discloses inventive examples having Al₂O₃ from 78.6 mass% (invention example no. A19) to 98.5% (invention example no. A27). Claim 1 has also been amended to make the claim language clearer.

Accordingly, no new matter has been introduced by the present amendment.

Entry of the foregoing amendment and consideration of the following remarks are respectfully requested.

Claim rejections under 35 U.S.C. §103

Claims 1 and 5-7 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,221,180 to Tosaka, et al. (“Tosaka”) for the reasons set forth on pages 3-8 of the Office Action.

Tosaka teaches that its steel contains 40% or less of Al₂O₃ in the oxide inclusions (*see, e.g.*, Tosaka, col. 4, l. 4; and col. 10, l. 65). Tosaka also teaches that when the Al₂O₃ content in the inclusions exceeds 40 wt%, the inclusions would have a high-melting point, inviting nozzle plugging, and, in addition, the shape of the inclusion becomes cluster-form to increase defects due to non-metallic inclusions in product steel sheets (*see* Tosaka, col. 11, ll. 28-33). Therefore, Tosaka clearly teaches that it is undesirable to have more than 40% of Al₂O₃ in the inclusions of the steel.

On the contrary, the steel of the presently claimed invention contains not less than 78.6 mass% of Al₂O₃ in the inclusions. In the present invention, the formation of large alumina cluster is prevented by limiting the REM-content in oxide-based inclusions. For example, by controlling the REM-oxide content in oxide-based inclusions consisting principally of alumina and REM-oxides to 0.5 to 15 mass % by adding one or more rare-earth metals (REMs) selected from the group of Ce, La, Pr and Nd to liquid steel deoxidized with Al, agglomeration and coalescence of alumina particles can be inhibited and the formation of coarse alumina clusters can be prevented. Tosaka does not teach or suggest controlling the REM-oxide content, much less its effect on formation of large alumina clusters. A person skilled in the art, based on the teachings of Tosaka, would not only not have obtained the

presently claimed steel, but also would have considered such a steel containing more than 40% of Al_2O_3 undesirable.

Furthermore, the present invention provides that the formation of coarse alumina clusters can be more surely prevented if the total REM content in the steel is controlled to not less than 0.1 ppm but less than 10 ppm with the dissolved REM being less than 1 ppm. According to the present invention, total REM is the sum of REM present in inclusions and dissolved REM in steel. The upper limit of total REM-content is set to under 10 ppm because the concentration of REM-oxides in oxide-based inclusions increases, the likelihood of alumina particles agglomeration and coalescence increases and coarse clusters are formed if the content is 10 ppm or above, as shown in Figure 3 of the present application. Meanwhile, the lower limit of total REM-content is set to 0.1 ppm because addition of REM does not bring about the desired effect to prevent the clustering of alumina particles if the content is under 0.1 ppm, as also shown in Figure 3 of the specification. Dissolved REM is controlled to less than 1 ppm because slags and dissolved REM in liquid steel react to produce large quantities of composite oxides of REM-oxides and alumina, thereby forming coarse clusters and deteriorating the cleanliness of liquid steel if dissolved REM exceeds 1 ppm. Also, ladle nozzle clogging occurs, as shown in Figure 4 of the present application if dissolved REM exceeds 1 ppm.

Tosaka teaches nothing about controlling the total REM content and dissolved REM content in their steel. One of ordinary skill in the art following the disclosure of Tosaka would not have obtained the steel of the present invention.

Therefore, the rejection of claims 1 and 5-7 under 35 U.S.C. §103(a) as obvious over Tosaka cannot stand, and should be withdrawn.

Claims 8 and 9 are rejected under 35 U.S.C. §103(a) as being unpatentable over Tosaka as applied to claims 1 and 5-8 above, in further view of EP 1 029 938 to Mizoguchi, et al. ("Mizoguchi") for the reasons set forth on pages 8-9 of the Office Action.

As discussed above, Tosaka does not disclose or suggest the presently claimed steel.

Mizoguchi is concerned with providing a rolled steel having few inclusion defects. According to Mizoguchi, the Al content in the steel is preferably kept in a range from 0.001 to 0.1% in order to prevent surface defects and internal defects. Mizoguchi, however, does not teach or suggest preventing the formation of alumina cluster by limiting the REM-content in oxide-based inclusions to 0.5 to 15 mass% and by adding one or more rare-earth metals

selected from the group of Ce, La, Pr and Nd to liquid steel deoxidized with Al. Additionally, Mizoguchi does not teach or suggest including no less than 78.6% of Al₂O₃ in total inclusions of their rolled steel as required by the present invention. Therefore, Mizoguchi does not disclose or suggest the presently claimed steel.

For at least the reasons presented above, one skilled in the art would not have arrived at the steel of the present invention based on the disclosure of Tosaka and the disclosure of Mizoguchi. Accordingly, the rejection of claims 8 and 9 under 35 U.S.C. §103(a) as obvious over Tosaka in further view of Mizoguchi cannot stand, and should be withdrawn.

In view of the foregoing amendments and remarks, Applicants respectfully submit that the present application is in condition for allowance. Early and favorable action by the Examiner is earnestly solicited. If the Examiner believes that issues may be resolved by a telephone interview, the Examiner is invited to telephone the undersigned at the number below.

Respectfully Submitted,

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